



ORIGINAL ARTICLE

15 years of minimally invasive paediatric cardiac surgery; development and trends[☆]



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Abstract

Introduction: The minimally invasive approach is seldom reported in paediatric cardiac surgery. Teams gathering experience are scarce, with programmes focused on simple cases. The experience is presented on a series of over 200 cases operated on in the past 15 years.

Material and methods: A sub-mammary approach programme was started in 2000, which was gradually extended to include more complex and younger patients. The axillary incision was adopted in 2009, following the same steps. In 2013, the mini-sternotomy incision was introduced, increasing our armamentarium. From July 2000 until December 2014, 203 patients were operated on. The sub-mammary approach was used in 102 cases, axillary in 50 patients, mini-sternotomy in 44, postero-lateral thoracotomy in 4 cases, and upper mini-sternotomy in 3.

Results: By diagnosis, ostium secundum atrial septal defect was the most common (128), followed by sinus venosus (20), ventricular septal defect (20), ostium primum (16), and others (19). One patient was converted to sternotomy. No neurological events were detected. The mean age was 7.8/3.7 and 1.8 years, and the mean weight was 28.1/16.1 and 9.4 kg, in the sub-mammary, axillary and mini-sternotomy approaches, respectively. The aesthetic results were excellent.

Conclusions: Based on our 15 years of experience, minimally invasive surgery is safe and yields excellent cosmetic results. The gradual introduction of alternative approaches (sub-mammary, axillary, mini-sternotomy) allowed us to set-up guidelines and learning curves. The wide range of incisions enables the most appropriate one to be selected depending on age/weight and cardiac condition.

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PALABRAS CLAVE

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15 años de cirugía cardíaca infantil miniinvasiva; evolución y tendencias**Resumen**

Introducción: Los abordajes miniinvasivos en cirugía cardíaca infantil no son habituales. Pocos grupos presentan programas y experiencia, quedando limitados a cardiopatías simples. Presentamos una casuística recopilada a lo largo de 15 años y más de 200 pacientes.

Material y métodos: En el año 2000 comenzamos un programa de acceso submamario, ampliándolo progresivamente a casos complejos y edades menores. En 2009 incorporamos el abordaje axilar, con idénticas pautas. En 2013 iniciamos la cirugía por miniesternotomía inferior, ampliando la cartera de servicios. Entre julio del 2000 y diciembre del 2014 se intervino a 203 pacientes: 102 por vía submamaria, 50 por axilar, 44 por miniesternotomía inferior, 4 por toracotomía lateral-posterior y 3 por miniesternotomía superior.

Resultados: Por patologías, la más frecuente fue la comunicación interauricular *ostium secundum* (128), seguida del seno venoso (20), comunicación interventricular (20), *ostium primum* (16) y otras (19). Un caso fue reconvertido a esternotomía. No hubo eventos neurológicos. Las medias de edad fueron 7,8/3,7 y 1,8 años, con medias de peso de 28,1/16,1 y 9,4kg en los accesos submamario, axilar y miniesternotomía, respectivamente. Los resultados estéticos han sido excelentes.

Conclusiones: Tras 15 años de experiencia acumulada, la cirugía miniinvasiva es segura y eficaz, con resultados estéticos excelentes. La introducción gradual de diferentes accesos alternativos permite establecer pautas de aprendizaje. La versatilidad de accesos (submamario, axilar, miniesternotomía) facilita la selección de abordajes en función de cardiopatía y edad/peso.

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Introduction

Due to the boom in interventional cardiology and the proliferation of techniques such as laparoscopy or thoracoscopy in other surgical specialties, several teams have adopted approaches alternative to median sternotomy.¹⁻⁷ The initial enthusiasm, fuelled by the technical advances of the past twenty-five years, stood against the reticence of those with a traditional approach. Doubts regarding the complexity and operative time of the technique, as well as its outcomes, prevented minimally invasive surgery from becoming widely used in congenital heart disease.

The most common surgical approaches used as alternatives to complete median sternotomy are: lower mini-sternotomy,⁸⁻¹¹ right anterolateral thoracotomy (submammary incision),^{1,12-16} right posterolateral thoracotomy,¹⁸ and right axillary thoracotomy.¹⁹⁻²³ Their advantages are mainly cosmetic, although other advantages have been described, such as lower use of blood products, lower rate of infection, and faster recovery. On the other hand, the most common drawbacks are the technical complexity and learning curve of these procedures, longer duration of extracorporeal circulation and aortic cross-clamping, and difficulty performing myocardial protection and de-airing manoeuvres.

In this article, we present our experience of fifteen years comprehending more than 200 cases. We describe the patient selection and exclusion criteria, and the manoeuvres used to address the drawbacks we have just mentioned. We give detailed information on the various approaches we have used and also on the criteria used for expanding the indications of these procedures to more complex cases and younger patients. Patient safety was the main consideration at all times.

Materials and methods

In year 2000, we launched a programme of minimally invasive paediatric heart surgery with submammary access. The first cases selected corresponded to female adolescents with developed breasts or a clearly defined inframammary fold with a diagnosis of ostium secundum (OS) atrial septal defect (ASD), having ruled out the presence of a left-sided superior vena cava (LSVC) and/or patent ductus arteriosus. A plastic surgeon assisted with accessing and closure of the thorax until we became familiar with the technique.¹⁶ In essence, the incision in the skin is made at the level of the submammary fold or sixth intercostal space, creating a pectoralis major myocutaneous flap²⁴ to enter the thoracic cavity through the fourth intercostal space. Both cannulation and surgical repair are performed through this single access, with no auxiliary incisions. Later on, we expanded the indication to younger patients (male and female) and other diseases that could be approached through the right atrium, such as sinus venosus (SV) ASD or ostium primum (OP) ASD.

After operating on 71 cases through this technique, we incorporated the axillary approach in 2009. Several studies^{25,26} warned of potential deformities of the breast or dorsal region as a result of anterolateral thoracotomy, and the axillary incision gained advocates.¹⁹⁻²¹ As a learning curve, we operated on several cases via posterolateral thoracotomy^{17,18} before "minimising" the incision towards the right axilla, sparing the latissimus dorsi and serratus.²⁷ As was the case in the submammary approach, the entire procedure was performed through the axillary incision. Also consistent with the submammary approach, the initial indication for this approach was OS ASD, with the subsequent addition of SV ASD.

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